PERFORMANCE OF GROUND IMPROVEMENT BY PRECOMPRESSION AND VERTICAL DRAIN

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ABSTRACT

Ground improvement is required when construction has to take place on geotechnically unsuitable material such as soft clay. This paper discusses the performance of ground improvement by pre-compression and vertical drain implemented for the construction of permanent campus of Universiti Malaysia Pahang (UMP) in Kuala Pahang, Pekan. The comparison was made in terms of engineering properties of the soil such as shear strength and compressibility characteristics before and after improvement and the achievement of criteria in terms of time and post construction settlement. The soil investigation showed that subsoil profile consisted of four layers whereby the thickness of compressible layer varies from 6 to 14 m. Settlement monitoring showed that the required pre-construction settlement was achieved in less than six months after the completion of ground improvement by pre-compression. Installation of the vertical drains in swampy area further reduced the consolidation time to about one month. The undrained shear strength *(Su)* of the soft compressible layer increased from 6 - 30 kPa to about 67 kPa while the compression index *(Cc)* decreased from about 0.2 - 0.6 to about 0.33. The coefficient of consolidation *(Cv)* of the soft soil layer decreases from $6m^2/yr$ - $21m^2/yr$ to about $2.11m^2/yr$ - $3.64m^2/yr$ due to compaction and consolidation process.

ABSTRAK

Pembaikan tanah adalah perlu sekiranya pembinaan terpaksa dilaksanakan di kawasan geoteknik yang tidak sesuai seperti tanah liat lembut. Kertas ini membincangkan pencapaian pembaikan tanah secara pramampatan dan saliran tegak yang telah digunakan dalam Kerja-kerja Tanah pembinaan Kampus Tetap Universiti Malaysia Pahang (UMP) di Kuala Pahang, Pekan. Perbandingan dibuat dari segi sifat-sifat kejuruteraan tanah seperti kekuatan ricih dan sifat-sifat kebolehmampatan sebelum dan selepas pembaikan dan kriteria pencapaian dari segi masa dan enapan selepas pembinaan. Penyiasatan tanah telah menunjukkan profil lapisan tanah bawah terdiri daripada empat lapisan yang mana ketebalan lapisan bolehmampatannya berubah-ubah dari 6 hingga 14 m. Pemantauan enapan telah menunjukkan keperluan enapan sebelum pembinaan dapat dicapai kurang dari enam bulan selepas siapnya pembaikan tanah secara pramampatan. Pemasangan saliran tegak di kawasan berpaya selanjutnya telah mengurangkan lagi masa pengukuhan tanah kepada kira-kira satu bulan. Kekuatan ricih tak bersalir *(Su)* bagi lapisan tanah lembut yang boleh dimampat telah meningkat dari 6 - 30 kPa kepada kira-kira 67 kPa manakala indeks pemampatan *(Cc)* telah menurun dari kira-kira 0.2 - 0.6 kepada kira-kira 0.33. Pekali pengukuhan *(Cv)* bagi lapisan tanah lembut telah menurun dari $6m^2$/tahun - $21m^2$/tahun kepada kira-kira $2.11m^2$/tahun - $3.64m^2$/tahun kesan daripada proses pemadatan dan pengukuhan tanah.

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CHAPTER 1

INTRODUCTION

1.1 Background

The population growth demands an increase in the development for human needs in such activities as agriculture, industry, housing and other infrastructure facilities. With the decrease in suitable land for the construction, the next choice available is to expand the development in the geotechnical challenging environment such as wetlands or soft soil area and highlands.

In Malaysia, soft soil deposits are widespread all over the country and mostly found in the coastal area. In general, soft soil posses low strength and high compressibility and thus having low bearing capacity. The soft soil condition needs to be improved to avoid excessive settlement and prevent stability failure that affecting the safety of the built infrastructure facilities.

Many ground improvement methods have been proposed and used on soft soil to improve its bearing capacity and minimize the anticipated settlement. The methods can be categorized as mechanical stabilization, chemical stabilization or inclusion of materials such as geosynthetics into the soil.

Precompression or preloading is one of the most effective and economical methods to reduce settlement and improve the bearing capacity of soft soil. The method is usually combined with vertical drain to speed up the consolidation process, hence; to minimize post-construction settlement.

1.2 Problem Statement

The precompression and vertical drain has been used successfully as a ground improvement method for soft soil. The method was implemented as ground improvement in the earthwork package of the development of permanent campus for Universiti Malaysia Pahang (UMP) to improve the subsoil and to reduce the time required for soil stabilization.

The performance of this ground improvement method can be evaluated by comparing the engineering properties of the subsoil before and after stabilization. In addition, the achievement of ground improvement criteria can be evaluated by observing the time required to reach the predetermined criteria of the ground improvement project through settlement monitoring.

1.3 Objective of the Study

The objectives of this study are as follows:

i. To evaluate the improvement of soil stabilized by pre-compression and vertical drain in terms of shear strength and consolidation properties.

ii. To make comparison in terms of consolidation times for cases of backfilling on original soil without and with surcharge preloading and with surcharge preloading and vertical drain.

iii. To evaluate the achievement of the predetermined criteria of the ground improvement project.

1.4 Scope of the Study

The scope of the study includes several aspects as follows:

i. Literature review on ground improvement by precompression and vertical drain.

ii. Back analysis of the performance of ground improvement by precompression and vertical drain implemented for the construction of permanent campus of Universiti Malaysia Pahang (UMP) in Kuala Pahang, Pekan.

iii. The effect of pore water pressure dissipation was not fully considered in the analysis due to insufficience of data obtained.

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